

MICROWAVE PLASMA DEVICE

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Inventor: INOUE TAKU

Applicant: SUMITOMO METAL IND

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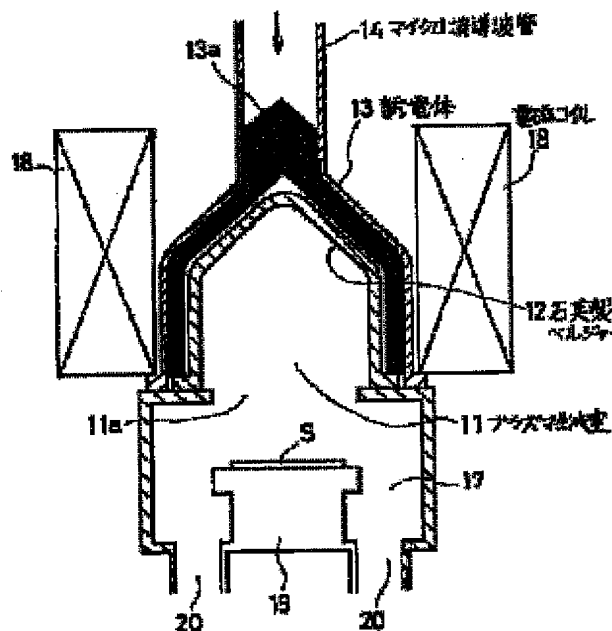
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Abstract of JP5062796

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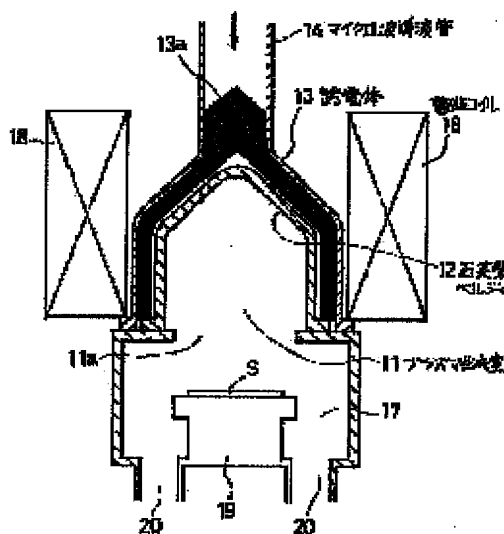
(72)Inventor : INOUE TAKU

(54) MICROWAVE PLASMA DEVICE

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CONSTITUTION: A microwave waveguide 14 guiding microwaves to a plasma generation chamber 11 is provided, and an electromagnetic coil 18 is arranged around the plasma generation chamber 11. The plasma generation chamber 11 is made of a microwave transmittable material, one end of the microwave waveguide 14 is connected to a microwave oscillator, and the other end surrounds the plasma generation chamber 11. A dielectric substance 13 is filled at the portion of the microwave waveguide 14 surrounding the plasma generation chamber 11.



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CLAIMS**[Claim(s)]**

[Claim 1] In the microwave plasma equipment with which the coil was arranged the microwave waveguide which leads microwave to a plasma production room -- having -- the perimeter of said plasma production room -- electromagnetism -- While said plasma production room is formed using the ingredient in which microwave transparency is possible, the end of said microwave waveguide It is microwave plasma equipment characterized by filling up with the dielectric the microwave waveguide part which it connected with the microwave oscillator, the other end was formed so that said plasma production room might be surrounded, and surrounded this plasma production room.

DETAILED DESCRIPTION**[Detailed Description of the Invention]****[0001]**

[Industrial Application] this invention -- microwave plasma equipment and the microwave waveguide which leads microwave to a plasma production room more at a detail -- having -- the perimeter of said plasma production room -- electromagnetism -- it is related with the microwave plasma equipment with which the coil was arranged.

[0002]

[Description of the Prior Art] The method of generating the plasma by electron cyclotron resonance (it being described as Following ECR) excitation can generate the plasma with high ionization degree by the low-gas-pressure force, can take the big ion current possible [extensive selection of ion energy], and has an advantage, such as excelling in the directivity and homogeneity of an ionic current. For this reason, researches and developments are briskly advanced to processes of a high frequency semiconductor device etc., such as thin film formation, etching, etc. in manufacture, as an indispensable thing.

[0003] Drawing 3 is the sectional view having shown typically the etching system as an example of conventional microwave plasma equipment, and 41 in drawing shows the plasma production room. It is divided with peripheral wall 41b which makes the shape of a cylindrical shape by which cooling water way 41a was formed in the interior, up wall 41c, and 41d of lower walls, the plasma production room 41 is constituted, and the microwave inlet 42 is formed in the center of abbreviation of up wall 41c. The closure is carried out by the microwave installation aperture 43 by which the microwave inlet 42 was arranged in that upper part, and the lower limit of a waveguide 44 is connected to the microwave inlet 42 through this microwave installation aperture 43. The microwave which the upper limit of a waveguide 44 was connected to the microwave oscillator which is not illustrated, and was generated with the microwave oscillator is drawn into the plasma production room 41 through a waveguide 44 and the microwave installation aperture 43. Furthermore, the gas supply line 45 is connected to up wall 41c, and the exiting coil 48 is arranged in the surroundings of it approximately concentrically with the plasma production room 41 over the plasma production room 41 side and the lower limit side of a waveguide 44.

[0004] On the other hand, the plasma drawer aperture 46 is formed in 41d of lower walls of the plasma production room 41, and the sample room 47 which is open for free passage with the plasma production room 41 under the plasma drawer aperture 46 with the plasma drawer aperture 46 is arranged. The sample base 49 which holds Sample S by an electrostatic chuck etc. is arranged in the part which counters the plasma drawer aperture 46 of the sample room 47, and the exhaust port 50 connected to the exhaustor which is not illustrated is formed in the lower wall of the sample room 47.

[0005] Thus, when performing etching processing to Sample S using the microwave plasma equipment constituted, after setting the inside of the plasma production room 41 and the sample room 47 as a necessary degree of vacuum first and supplying necessary gas through a gas supply line 45 in the plasma production room 41 subsequently, microwave is introduced in the plasma production room 41 from a waveguide 44, forming a

field with an exiting coil 48. Then, resonance excitation of the gas is carried out by using the plasma production room 41 as a cavity resonator, and the plasma occurs in the plasma production room 41. The generated plasma is projected on the outskirts of sample S in the sample room 47 by the emission field to which flux density is falling as it goes to the sample room 47 side formed with the exiting coil 45, and, thereby, etching is performed to a sample S front face.

[0006]

[Problem(s) to be Solved by the Invention] In the above-mentioned microwave plasma equipment, an emission field is formed with an exiting coil 48, a charged particle exercises along with line of magnetic force, and the ion in the plasma which contributes to etching or membrane formation carries out incidence to Sample S. However, the microwave inlet 42 used as the microwave induction to the plasma production room 41 was carrying out localization to the central upper part section of the plasma production room 41, since the plasma drawer aperture 46 was moreover also formed in the central lower part section of the plasma production room 41, distribution of the plasma consistency in a sample S front face became high in the sample S core, and or the core where a plasma consistency is high was quick also in processing speed and was not formed by homogeneity, a technical problem called etching occurred.

[0007] This invention can be made in view of the above-mentioned technical problem, and the plasma can be distributed over the sample front face S at homogeneity, therefore thing processing speed in the sample front face by the plasma can be made into homogeneity, and it aims at offering the microwave plasma equipment which can perform outstanding etching or uniform membrane formation of a configuration.

[0008]

[Means for Solving the Problem] The microwave plasma equipment applied to this invention in order to attain the above-mentioned purpose in the microwave plasma equipment with which the coil was arranged the microwave waveguide which leads microwave to a plasma production room -- having -- the perimeter of said plasma production room -- electromagnetism -- While said plasma production room is formed using the ingredient in which microwave transparency is possible, the end of said microwave waveguide it connects with a microwave oscillator, the other end is formed so that said plasma production room may be surrounded, and it is characterized by filling up with the dielectric the microwave waveguide part which surrounded this plasma production room.

[0009]

[Function] In the microwave plasma equipment with which the coil was arranged the microwave waveguide which leads microwave to a plasma production room according to the above-mentioned equipment -- having -- the perimeter of said plasma production room -- electromagnetism -- While said plasma production room is formed using the ingredient in which microwave transparency is possible, the end of said microwave waveguide Since the microwave waveguide part which it connected with the microwave oscillator, the other end was formed so that said plasma production room might be surrounded, and surrounded this plasma production room is filled up with the dielectric From said dielectric with which said microwave waveguide point was filled up with microwave, it is mostly introduced over the whole region, and at this plasma production room, the plasma generates a uniform consistency, and the generated plasma of said plasma production interior of a room is led to a sample by the field. Therefore, the plasma with a uniform consistency will arrive at all sample front faces, and etching or film formation is performed at a homogeneity rate.

[0010]

[Example] Hereafter, the example of the microwave plasma equipment concerning this invention is explained based on a drawing.

[0011] Drawing 1 is the sectional view having shown typically one example of the microwave plasma equipment concerning this invention, 11 in drawing shows the plasma production room formed in the plane view circle configuration, and the plasma production room 11 is formed of the bell jar 12 made from a quartz in which microwave transparency is possible. The end of a microwave waveguide 14 is connected to the microwave oscillator which is not illustrated, and the other end is arranged so that the bell jar 12 made from a quartz may be surrounded. Microwave waveguide 14 part surrounding this quartz bell jar 12 is filled up with the dielectric 13 made from Teflon. If a dielectric 13 has a certain amount of thickness (for example, about 20mm), it is enough as a dielectric wire way, and the radiation condition of the microwave from the dielectric 13 to the plasma production room 11 can be adjusted by making thickness of a dielectric 13 thin or losing a dielectric 13 on the way. Moreover, the upper limit side of a dielectric 13 serves as a gestalt omitted aslant, and reflection of the microwave from a

microwave oscillator can be reduced by forming inclined plane 13a in this way. And through microwave waveguide 14 and a dielectric 13, the microwave generated with the microwave oscillator penetrates the bell jar 12 made from a quartz, and is drawn into the plasma production room 11.

[0012] The plasma production room 11 and the sample room 17 open for free passage are arranged through plasma drawer aperture 11a by the lower part of the plasma production room 11.

[0013] Moreover, the sample base 19 which holds Sample S by an electrostatic chuck etc. is arranged in plasma drawer aperture 11a of the center of abbreviation of the sample room 17, and the part which counters, and the exhaust port 20 is formed in the both sides of the sample base 19.

[0014] on the other hand – the surroundings the plasma production room 11 and near the lower limit section of a microwave waveguide 14 – the plasma production room 11 – approximately concentrically – electromagnetism – the coil 18 is arranged.

[0015] Thus, in the constituted microwave plasma equipment, after laying Sample S in the sample base 19, the inside of the plasma production room 11 and the sample room 17 is set as a necessary degree of vacuum, and necessary gas is supplied through the gas supply line which is not illustrated subsequently to in the plasma production room 11. and electromagnetism – conduction of the direct current is carried out to a coil 18.

Microwave is led to the plasma production room 11 through a microwave waveguide 14 and a dielectric 13, and the plasma production room 11 is made to generate the plasma. on the other hand – electromagnetism – the conduction to a coil 18 – the plasma production room 11 – a downward field is mostly formed uniformly over the whole region, and the plasma is poured out by the uniform consistency to Sample S by this emission field.

[0016] Thus, if microwave is introduced in the plasma production room 11 from a microwave waveguide 14, forming a field, resonance excitation of the gas will be carried out by using the plasma production room 11 as a cavity resonator, and the plasma will occur efficiently in the large field in the plasma production room 11.

Moreover, since microwave is supplied by the homogeneity consistency in the plasma production room 11 with a dielectric 13, in the abbreviation whole region in the plasma production room 11, the plasma will occur in homogeneity, the ion in the plasma will carry out incidence by the homogeneity consistency to Sample S, and processing will be performed on a sample S front face at a homogeneity rate.

[0017] Drawing 2 is the sectional view having shown typically another example of the microwave plasma equipment concerning this invention, and 21 in drawing shows the plasma production room formed in the semi-sphere configuration. The plasma production room 21 is formed of the bell jar 22 made from a quartz in which microwave transparency is possible, and as the bell jar 22 made from a quartz is surrounded, the end section of a microwave waveguide 24 is arranged. The end section of this microwave waveguide 24 is filled up with the dielectric 23 made from Teflon, and the microwave oscillator side edge side of a dielectric 23 has become inclined plane 23a. Moreover, the right end of a microwave waveguide 24 is connected to the microwave oscillator which is not illustrated. And through microwave waveguide 24 and a dielectric 23, the microwave generated with the microwave oscillator penetrates the bell jar 22 made from a quartz, and is drawn into the plasma production room 21.

[0018] The plasma production room 21 and the sample room 27 open for free passage are arranged by the lower part of the plasma production room 21.

[0019] Moreover, the sample base 19 which holds Sample S by an electrostatic check etc. is arranged in the part located in the center of abbreviation of the sample room 27, and the exhaust port 30 is formed down the sample base 19.

[0020] on the other hand – the surroundings the plasma production room 21 and near the lower limit section of a microwave waveguide 24 – the plasma production room 21 – approximately concentrically – electromagnetism – the coil 28 is arranged.

[0021] The same operation effectiveness as the thing of the example shown in drawing 1 also in the thing of the example shown in drawing 2 can be acquired.

[0022]

[Effect of the Invention] If it is in the microwave plasma equipment applied to this invention by the above explanation so that clearly In the microwave plasma equipment with which the coil was arranged the microwave waveguide which leads microwave to a plasma production room – having – the perimeter of said plasma production room – electromagnetism – While said plasma production room is formed using the ingredient in which microwave transparency is possible, the end of said microwave waveguide Since the microwave waveguide part which it connected with the microwave oscillator, the other end was formed so that said plasma

production room might be surrounded, and surrounded this plasma production room is filled up with the dielectric microwave -- said microwave waveguide and said dielectric -- minding -- said plasma production interior of a room -- it is mostly introduced over the whole region and this plasma production interior of a room is made to generate the plasma by the uniform consistency Therefore, the plasma will be supplied to a sample front face at homogeneity, and a sample front face can be processed at a homogeneity rate.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view having shown one example of the microwave plasma equipment concerning this invention in ** type.

[Drawing 2] It is the sectional view having shown another example of the microwave plasma equipment concerning this invention in ** type.

[Drawing 3] It is the sectional view having shown an example of conventional microwave plasma equipment roughly.

[Description of Notations]

11 21 Plasma production room

12 22 Bell jar made from a quartz

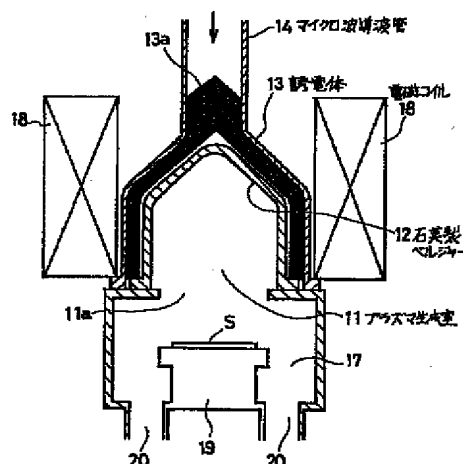
13 23 Dielectric

14 24 Microwave waveguide

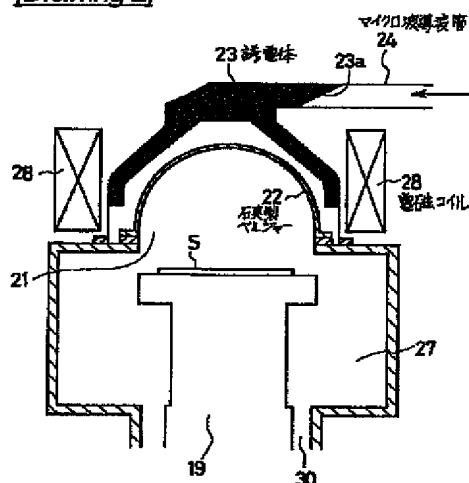
18 and 28 electromagnetism -- coil

DRAWINGS

[Drawing 1]



[Drawing 2]



[Drawing 3]

